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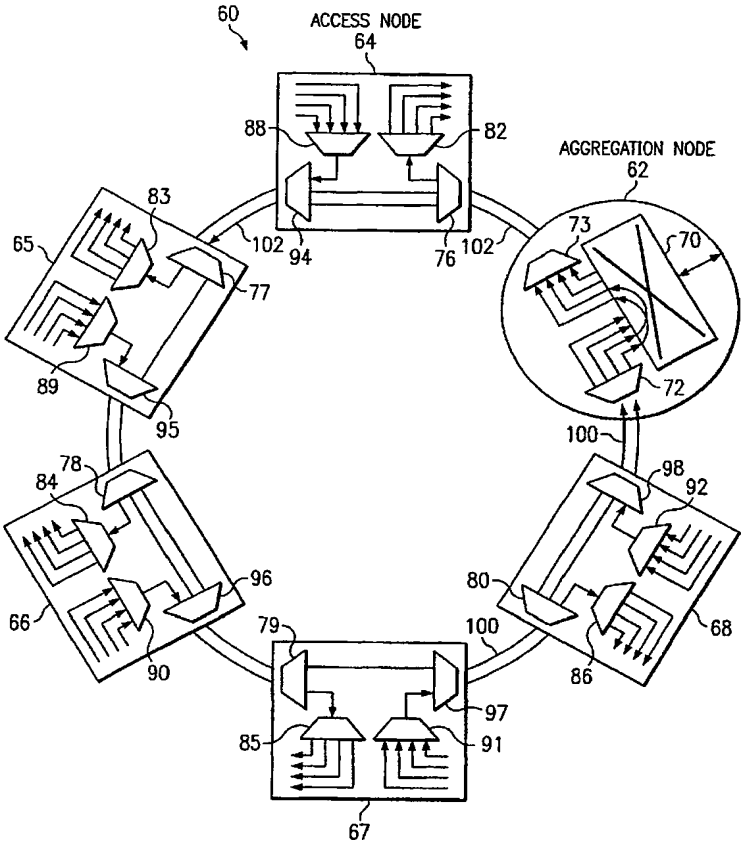

(57) Abstract: A network includes a plurality of nodes (64-68) coupled to one another, each node operable to add/drop a plurality of signals, and an aggregation node (62) having a switching element (70) coupled to the plurality of nodes (64-68), the switching element (70) operable to route the plurality of signals from a source node to a destination node.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

CENTRALIZED SWITCHING SYSTEM AND METHOD IN A RING NETWORK

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to the field of telecommunications, and more particularly to centralized switching system and method in a ring network.

BACKGROUND OF THE INVENTION

Metropolitan or regional access networks are typically optical networks having a ring configuration. These access networks may serve telecommunications customers in a portion of or an entire metropolitan area. The access networks connect customers and distribution networks to the backbone network. Each access node in the access network includes an optical add-drop multiplexer that incorporates a switching element to add or drop specific optical wavelengths. In this conventional implementation, each access node in the network has access to all of the wavelengths and connectivity to all other access nodes in the access network.

SUMMARY OF THE INVENTION

It has been recognized that the inclusion of a switching element in each access node of the access network carries a significant cost. The present invention provides for a system and method for centralized switching in an access network where only one specialized node in the network includes a switch for routing the signals.

In accordance with an embodiment of the present invention, a network includes a plurality of nodes coupled to one another, each node operable to add/drop a plurality of signals, and an aggregation node having a switching element coupled to the plurality of nodes, the switching element operable to route the plurality of signals from a source node to a destination node.

In accordance with another embodiment of the present invention, an optical access network includes a plurality of nodes coupled to one another in a ring configuration, each node operable to add/drop a plurality of optical signals, and an aggregation node having a switching element coupled to the plurality of nodes in the ring configuration. The aggregation node is operable to route optical signals from a source node to a destination node using the switching element.

In accordance with another embodiment of the present invention, an optical access network includes a plurality of nodes coupled to one another in a ring configuration, each node having an optical-to-electrical converter operable to convert optical signals to electrical signals for termination, and an electrical-to-optical converter operable to convert electrical signals received by the node to optical signals for transmission in the network. The network further includes an aggregation node having a switching element coupled to the plurality of nodes in the ring configuration, the aggregation node having an optical-to-electrical converter operable to convert optical signals to electrical signals for termination or

switching by the switching element, and an electrical-to-optical converter operable to convert electrical signals to optical signals for transmission to a node in the access network.

In accordance with another embodiment of the present invention, a network includes a plurality of nodes coupled to one another, each node operable to receive a plurality of signals from outside the network, transmit the plurality of signals within the network, and send the plurality of signals out of the network. The network also includes an aggregation node having a switching element and coupled to the plurality of nodes in a ring configuration, the aggregation node being operable to route the plurality of signals from a source node to a destination node in the network using the switching element.

In accordance with yet another embodiment of the present invention, a method of routing signals in a ring access network includes the steps of receiving a plurality of signals at a source node, where the source node coupled with a plurality of network nodes in a ring configuration, routing the plurality of signals to an aggregation node, switching the plurality of signals by a switch in the aggregation node from source paths to destination paths, and routing the plurality of signals to a destination node in the network.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, the objects and advantages thereof, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

FIGURE 1 is a simplified diagram of a conventional access ring network; and

FIGURE 2 is a simplified diagram of an embodiment of an access ring network with centralized switching according to the teachings of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES 1 and 2 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

FIGURE 1 is a simplified diagram of a conventional access ring network 10. Network 10 includes a plurality of access nodes 12-17. Each access node includes an optical-to-electrical converter 20-26 for converting the optical wavelengths into electrical signals, a demultiplexer 28-33 for demultiplexing the electrical signals, and a switching element 35-40 for routing the signals and add/dropping customer traffic. Each access node also includes a multiplexer 42-47 coupled to the switching element to multiplex signals that are destined for another access node in the network. At each node, the multiplexed signals are converted by an electrical-to-optical converter 48-53 and transmitted to a destination node in the network. As discussed above, implementing access network 10 is cost prohibitive because each access node includes a switching element.

FIGURE 2 is a simplified diagram of an embodiment of an access ring network 60 with centralized switching according to the teachings of the present invention. Access ring network 60 includes an aggregation node 62 and a plurality of access nodes 64-68. Aggregation node 62 includes a switch element 70 such as a cross-bar switch. Aggregation node 62 further includes optical-to-electrical converter and multiplexer 72 for terminating all wavelengths and passes them electrically to switch 70 for routing. Switch 70 switches certain traffic to another network node in another network, such as another aggregation node or to an access node in access network 60. Access nodes 64-68 each includes an optical-to-electrical converter 76-80, a demultiplexer 82-86, a multiplexer 88-92, and an electrical-to-optical converter 94-98, respectively. Optical signals may pass between the demultiplexer and multiplexer at each access node to allow the traffic to continue to the next node in the access network. The links connecting aggregation node 62 and access nodes 64-68 may carry a plurality of wavelengths of optical signals bidirectionally.

Because aggregation node 52 is the only network node that includes a switch element 70 for routing the signals, the connectivity between the access nodes in the network is no longer direct and is provided on a provisioning basis through the aggregation node. For example, in order for routing a signal from access node 67 to access node 65, a channel or wavelength 100 is provisioned between access node 67 to aggregation node 62, and a second channel or wavelength 102 is provisioned between aggregation node 62 and access node 65. A path going in the opposite direction from node 65 to node 67 through the aggregation node may also be provisioned similarly.

It may be seen that the cost for the overall access network is reduced significantly by eliminating the switching element from all but one network node. The present invention is applicable to any network that may be more economically implemented by using a central switching element to route traffic in the network rather than a distributed switching arrangement.

While the invention has been particularly shown and described by the foregoing detailed description, it will be understood by those skilled in the art that various other changes in form and detail may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A network, comprising:

a plurality of nodes coupled to one another, each node operable to add/drop a plurality of signals; and

an aggregation node having a switching element coupled to the plurality of nodes, the switching element operable to route the plurality of signals from a source node to a destination node.

2. The network, as set forth in claim 1, wherein the plurality of nodes and aggregation node are coupled in a ring configuration.

3. The network, as set forth in claim 1, wherein the plurality of nodes and aggregation node are operable to add/drop a plurality of optical signals and to transmit the optical signals to one another along a plurality of light paths.

4. The network, as set forth in claim 1, wherein the aggregation node comprises an optical-to-electrical converter operable to convert the plurality of signals in the network from optical to electrical signals for switching by the switching element, and an electrical-to-optical converter operable to convert the switched electrical signals to optical signals for transmission to another node in the network.

5. The network, as set forth in claim 1, further comprising a first light path having a first wavelength from the source node to the aggregation node and a second light path having a second wavelength from the aggregation node to the destination node.

6. An optical access network, comprising:

a plurality of nodes coupled to one another in a ring configuration, each node operable to add/drop a plurality of optical signals; and

an aggregation node having a switching element coupled to the plurality of nodes in the ring configuration, the aggregation node operable to route optical signals from a source node to a destination node using the switching element.

7. The network, as set forth in claim 6, wherein the plurality of nodes and aggregation node are operable to add/drop a plurality of optical signals and to transmit the optical signals to one another along a plurality of light paths.

8. The network, as set forth in claim 6, wherein the aggregation node comprises optical-to-electrical converters operable to convert the plurality of signals in the network from optical to electrical signals for switching by the switching element, and electrical-to-optical converters operable to convert the switched electrical signals to optical signals for transmission to another node in the network.

9. The network, as set forth in claim 6, further comprising a first light path having a first wavelength from a source node to the aggregation node and a second light path having a second wavelength from the aggregation node to a destination node.

10. An optical access network, comprising:

a plurality of nodes coupled to one another in a ring configuration, each node having an optical-to-electrical converter operable to convert optical signals to electrical signals for termination, and an electrical-to-optical converter operable to convert electrical signals received by the node to optical signals for transmission in the network; and

an aggregation node having a switching element coupled to the plurality of nodes in the ring configuration, the aggregation node having an optical-to-electrical converter operable to convert optical signals to electrical signals for termination or switching by the switching element, and an electrical-to-optical converter operable to convert electrical signals to optical signals for transmission to a node in the access network.

11. The network, as set forth in claim 10, wherein the plurality of nodes and aggregation node are operable to add/drop a plurality of optical signals and to transmit the optical signals to one another along a plurality of light paths.

12. The network, as set forth in claim 6, further comprising a first light path having a first wavelength from a source node to the aggregation node and a second light path having a second wavelength from the aggregation node to a destination node.

13. A network, comprising:

a plurality of nodes coupled to one another, each node operable to receive a plurality of signals from outside the network, transmit the plurality of signals within the network, and send the plurality of signals out of the network; and

an aggregation node having a switching element and coupled to the plurality of nodes in a ring configuration, the aggregation node operable to route the plurality of signals from a source node to a destination node in the network using the switching element.

14. The network, as set forth in claim 13, wherein the plurality of nodes and aggregation node are operable to add/drop a plurality of optical signals and to transmit the optical signals to one another along a plurality of light paths.

15. The network, as set forth in claim 13, wherein the aggregation node comprises an optical-to-electrical converter operable to convert the plurality of signals in the network from optical to electrical signals for switching by the switching element, and an electrical-to-optical converter operable to convert the switched electrical signals to optical signals for transmission to another node in the network.

16. The network, as set forth in claim 13, further comprising a first light path having a first wavelength from the source node to the aggregation node and a second light path having a second wavelength from the aggregation node to the destination node.

17. A method of routing signals in a ring access network, comprising:

receiving a plurality of signals at a source node, the source node coupled with a plurality of network nodes in a ring configuration;

routing the plurality of signals to an aggregation node;

switching the plurality of signals by a switch in the aggregation node from source paths to destination paths; and

routing the plurality of signals to a destination node in the network.

18. The method, as set forth in claim 17, further comprising:

converting the plurality of signals from optical to electrical signals prior to switching the plurality of signals; and

converting the switched plurality of signals from electrical to optical prior to routing to the destination node.

FIG. 1

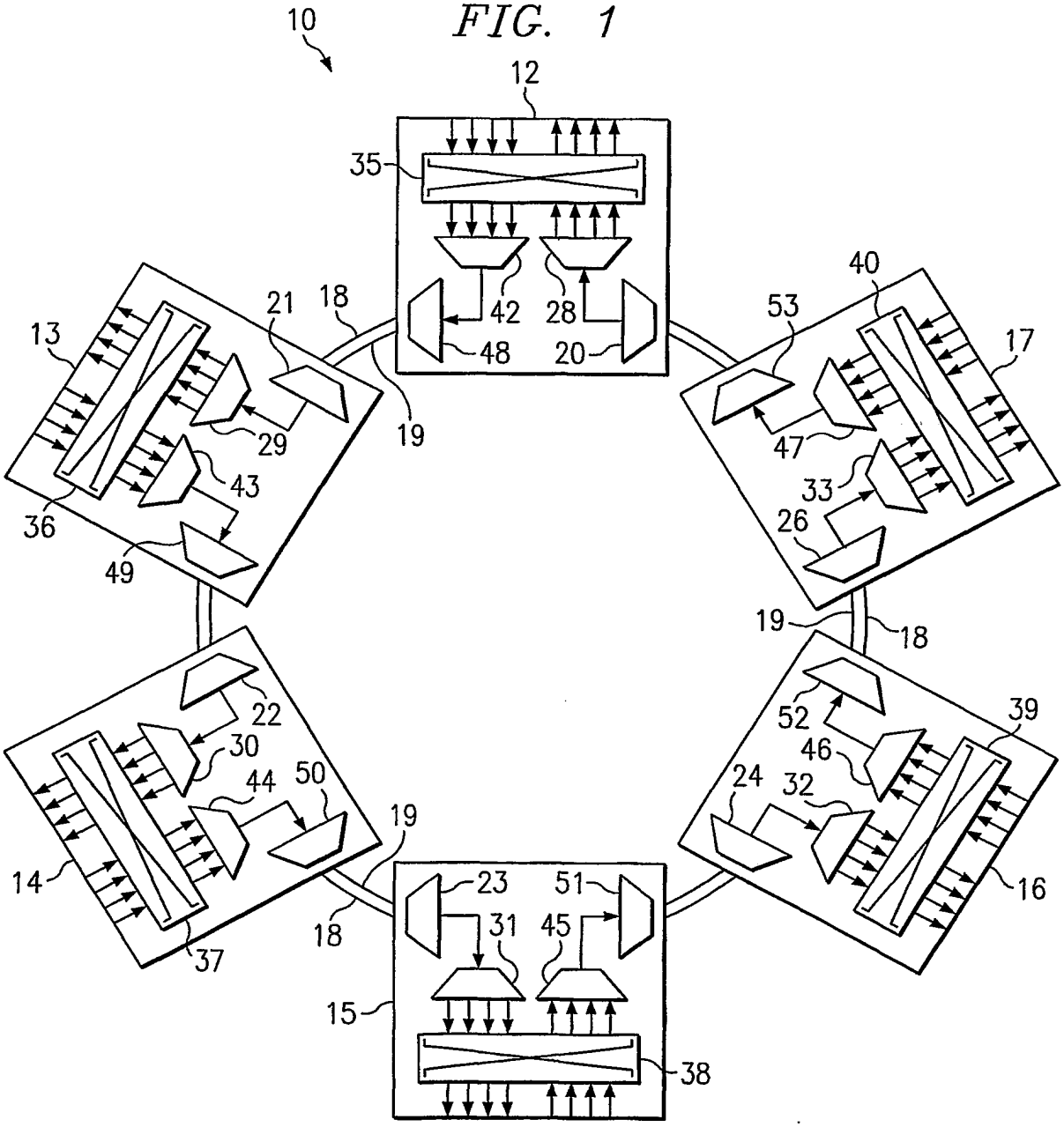
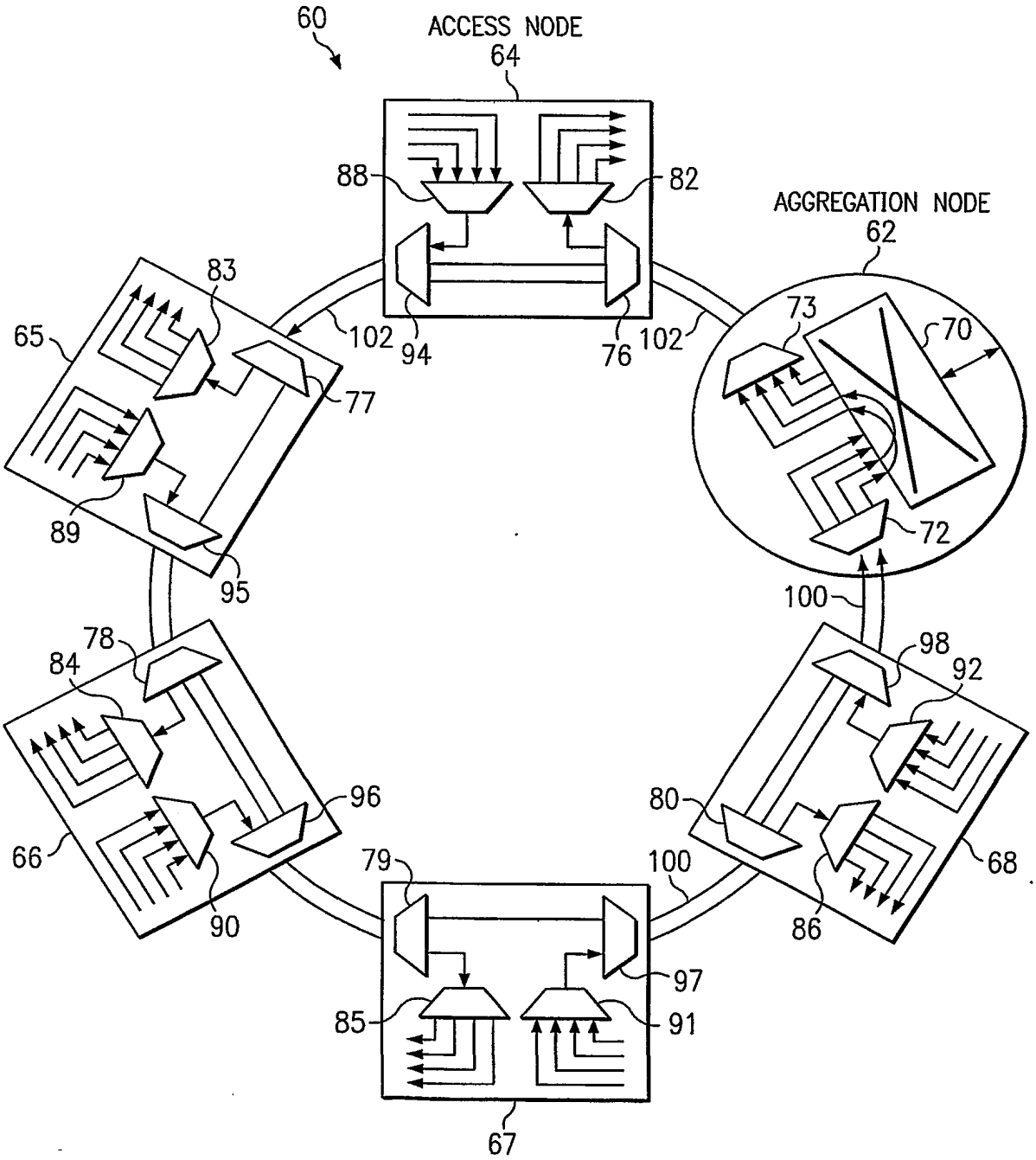


FIG. 2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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/17377

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : H04L 12/28; H04J 14/02
US CL : 370/258, 400, 406, 467; 359/117, 118
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 370/258, 389, 400, 404, 405, 406, 424, 467; 359/117, 118, 133

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,233,074 B1 (LAHAT et al.) 15 May 2001, column 8, lines 21-67; column 5, lines 36-65.	1-4, 6-8, 10, 11, 13-15, 17 and 18 --- 5, 9, 12 and 16
Y	US 5,717,795 A (SHARMA et al.) 10 February 1998, column 2, line 55-column 3, line 56.	5, 9, 12 and 16
A,P	US 6,339,488 B1 (BESHAI et al.) 15 January 2002, entire document.	1-18
A	US 6,094,417 A (HANSEN et al.) 25 July 2000, entier document.	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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INTERNATIONAL SEARCH REPORT

PCT/US02/17377

Continuation of B. FIELDS SEARCHED Item 3:
EST, IEEE
search terms: aggregation node, edge node, switch, add/drop, ring